UNIVERSITY OF SASKATCHEWAN

College of Engineering

G.E. 120.3

Introduction to Engineering II

FINAL EXAMINATION #2

April 13, 2004

2:00 PM - 4:00 PM

STUDENT NAME: _____

STUDENT NUMBER: _____

LECTURE SECTION:

- L02 Tu-Th 11:30 – 1:00 Prof. H.C. Wood
- L04 Tu-Th 1:00 – 2:30 Prof. T.A. Fonstad
- L06 Tu-Th 2:30 – 4:00 Prof. D.X.B. Chen

Question 1	/ 10
Question 2	/ 10
Question 3	/ 10
Question 4	/ 10
Question 5	/ 10
Question 6	/ 20
Question 7	/ 20
TOTAL	/ 90

GENERAL INSTRUCTIONS FOR THE QUESTIONS

1) **NO** textbooks, **NO** notes, **NO** assignments, and **NO** laboratory logbooks/reports.

2) **NO calculators allowed**.

3) Neatness counts. Please ensure your paper is readable.

4) Some questions contain special instructions. Please ensure that you read these carefully.

5) Not all questions are of the same difficulty and value. Consider this when allocating time for the solution.

6) *IF A QUESTION PROVES TO BE TOO HARD FOR YOU TO SOLVE, GO ON TO ANOTHER QUESTION! RETURN TO THE TROUBLESOME QUESTION WHEN TIME PERMITS.*

PLEASE NOTE

ALL parts of the examination paper MUST be handed in before leaving.

Please check that your examination paper contains 10 pages TOTAL.

QUESTION #1

MARKS: 10 (5x1 + 5)

Discipline Lectures/Labs

In the Civil Lab, Methane gas was of interest because of its detrimental effect as a greenhouse gas, and its potential as an energy source. APPROXIMATELY what percentage of total landfill gas was methane?

a) 10% b) 25% c) 50% d) 75% e) 90%

In the Mechanical Lab, what CRITERIA was used for design evaluation

a) How much Synchrotron Light contacted the mask
b) The intensity of the Synchrotron Light
c) How much water flowed through the mask
d) That the maximum allowable temperature wasn't exceeded on the mask
e) That a Reynolds Number of at least 100,000 was achieved

In the Electrical Lab, which of the following statements was true about the average daily power output of the solar panel as compared to the wind turbine.

a) The solar panel produced about 10 times as much power as the wind turbine
b) The solar panel produced about twice as much power as the wind turbine
c) The solar panel and the wind turbine both produced about the same output
d) The wind turbine produced about twice as much power as the solar panel
e) The wind turbine produced about 10 times as much power as the solar panel

In the Engineering Physics Lab, which of the following was required?

a) Distances calculated using the speed of light
b) 3D geometry transformations
c) Guessing answers
d) All of the above
e) None of the above

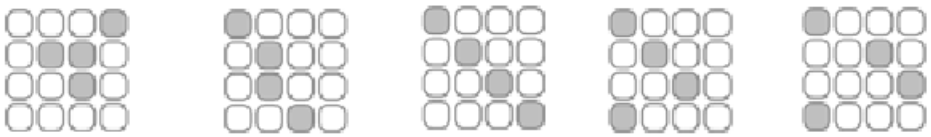
In the Mechanical Engineering Discipline Lecture, Micro Electro-Mechanical Systems (MEMS) were discussed. A gear was shown on which of the following?

a) The head of a pin
b) The side of a penny
c) A circuit board
d) The head of an ant
e) A watch battery

Logic Problem

For the picture sequence above, find the picture that follows logically from one of the five below.

Circle the letter of the correct answer.



A) **B)** **C)** **D)** **E)**

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QUESTION #2

MARKS: 10 (5+5)

A. Which of the following vectors are orthogonal to eachother?

u = [1 -2 3], **v** = [4 5 -1], **w** = [2 7 4].

Show your work.

B. Determine the angle between the vectors; u = [3 0 -1] and v = [2 0 1]

QUESTION #3

MARKS: 10 (2 + 2 + 6)

Given two points p and v, and a line γ by the homogeneous vectors

$p = [3\ 4\ 1]$, $v = [2\ -2\ 1]$, $g = \begin{bmatrix} 1 \\ -1 \\ 1 \end{bmatrix}$,

Determine:

a) the ordinary coordinates of the points p and v,
b) the equation of the line expressed in ordinary coordinates,
c) which point is on the line and what the distance is from the other point to the line.

QUESTION #4

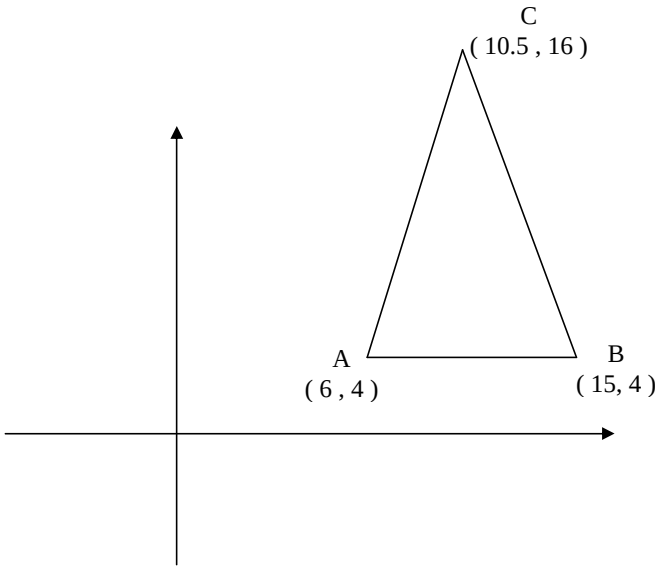
MARKS: 10 (3 + 4 + 3)

A. The following shape is to be scaled DOWN by a factor of 3 in the "x" direction and a factor of 2 in the "y" direction AND rotated π radians. (Show your work.)

i) What is the combined transformation matrix?

ii) What are the values of the final coordinates of each point (ie. A', B' and C')?

B. Sketch your solution.



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QUESTION #5

MARKS: 10 (2+1+1+2+1+3)

A. A complex number has an imaginary part of minus 8 and a real part of 6.

Write the Matlab commands to enter this number into a variable, z, for
a) polar coordinates
b) rectangular coordinates.

B. Write the MatLab command to take the vector from the previous question and rotate it 90° counter clockwise.

C. What does the command c=sum(a.*b) do, assuming a and b are vectors?

D. Write the MatLab command to calculate the cosine of 45°, and assign it to the variable w.

E. Which MatLab command allows the resolution of the correct quadrant of angles?

F. Enter the series of Matlab commands to load and execute the following:
A number **r** with a ***magnitude of 2*** and an ***angle of π/4***, with ***r*** then ***raised to the power of 10***.

QUESTION #6

MARKS: 20 (2 + 4 + 8 + 6)

Answer each of the following questions.

a) Find all solutions to the equation: $x^2 + 9 = 0$

b) Sketch the following complex numbers in the complex plane, and then express them in the polar form (given that $\tan^{-1}(1)=45^o$)
(1) $Z_1 = 2 - 2i$
(2) $Z_2 = -3 + 3i$

c) Express the following expressions in the form of $a+bi$ (given that $\tan^{-1}\left(\sqrt{3}\right)=60^o$)
(1) $\dfrac{(5+3i)(1+5i)}{2(1-2i)}$

(2) $\left(\dfrac{1}{2}+\dfrac{\sqrt{3}}{2}i\right)^6$

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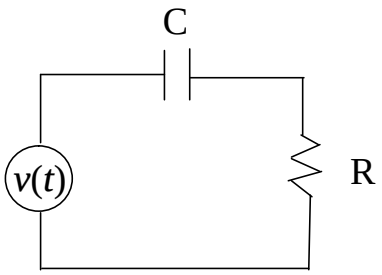
d) Consider the following circuit consisting of a capacitor (C) and a resistor (R) in series, with the voltage supply given by $v(t) = V_0 \sin(wt)$, express the total impendence of the circuit in the polar form (It is known that the impedance of a resistor equals to its resistance, and that the impedance of a capacitor equals to 1/(ωCj))



QUESTION #7

MARKS: 20 (12 + 8)

1. A swimming pool is rectangular in shape, 50 m long and 20 m wide. The pool has a deep end for diving and a shallow end for beginners, as shown in a cross section in Figure 1. As shown in the figure, the transition from the shallow to the deep end is curved, and it is of uniform shape across the width of the pool. The shallow section, out to point A, is horizontal, then points B, C, D etc. are successively 50 cm deeper than the preceding point. The horizontal distances from the shallow end of the pool to point A, B, C…..I, are as follows, respectively: 10.0m, 14.7m, 18.8m, 22.2m, 25.0m, 27.2m, 28.8m, 29.7m, and 30.0m. Assume the segments connecting the points are straight lines (flat surfaces actually).

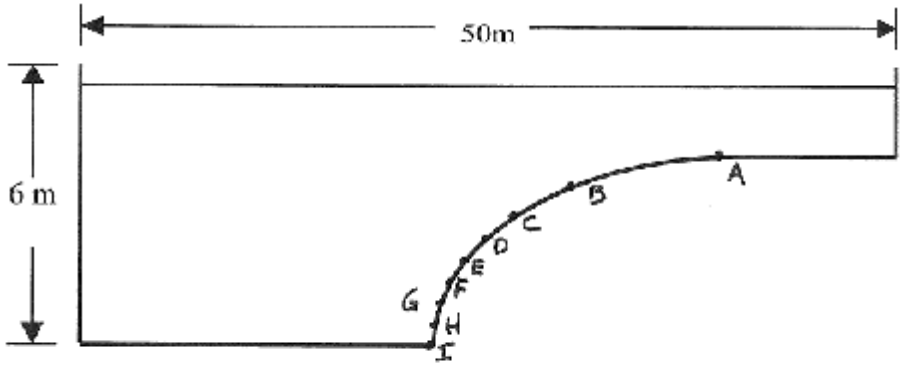


FIGURE 1

If the maximum depth of the pool is 6.0 m, but it is only filled to within 0.5 m of the top, how much water is contained in the pool? How much additional water must be added to raise the level 20 cm?

2. A drill bit for drilling an oil well is in the shape of a cone, as shown in Figure 2. The base of the cone, attached to the drill stem, is 30 cm in diameter, and the cross section of the drill bit as shown is an equilateral triangle. The drill has hollow sections that allow the removed material to be extracted and lifted to the surface with drilling mud (not shown), but the cutting surface is in the shape shown in the diagram. If the tip of the drill (and therefore the whole drill) advances 10 cm down the well, what volume of rock has to be removed?

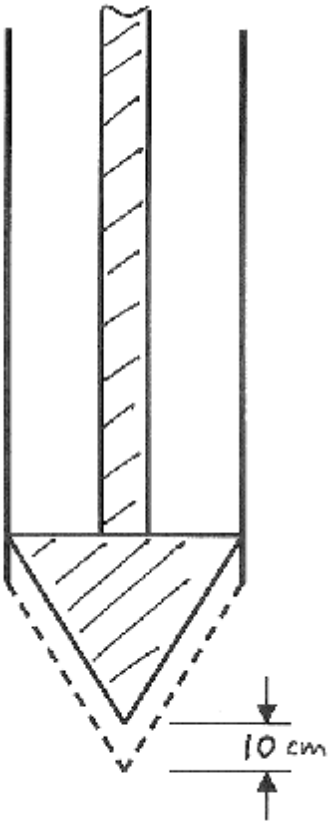


FIGURE 2

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